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Melvin Borrego
Eric Brown
Yates Coulter
John Dunwoody
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Vitae

Melvin Borrego *Serving the nation through neutron science and National Guard missions*

For one year in Iraq, Melvin Borrego drove the lead five-ton cargo truck in convoys that delivered food, ammunition, and other logistical supplies to United States soldiers. On the road, he braced for sniper attacks, ambushes, and homemade bomb explosions. He also provided a secured area for all soldiers at Camp Cook in Taji, a village just north of Baghdad that was under constant mortar attack. He mourned the deaths of five close friends from the Arkansas National Guard.

With life-threatening dangers weighing on his mind, Borrego said he was glad he didn't have to worry about his wife and two children back in Española. "My family was taken care of," said Borrego, of the Lujan Neutron Scattering Center (LANSCE-LC). "They had the support of family, friends, the New Mexico Army National Guard Family Support Program, and Los Alamos National Laboratory."

For 16 of the 18 years that Borrego has served with the National Guard, he has worked at the Lujan Center, winning awards in both positions. To show his gratitude to the Laboratory for years of support, Borrego nominated Los Alamos National Laboratory for the 2013 Secretary of Defense Freedom Award, which recognizes employers for outstanding support of National Guard and U.S. Army Reserve members. Los Alamos received an Above and Beyond Award, but did not advance to the national competition.

"When I was deployed, they went above and beyond," Borrego said. "It's like a family over here—you're not just a number."

Every payday, a member of the group office would call his wife, Angela, to confirm she had received Borrego's Laboratory paycheck, which supplemented his National Guard wages. The Lujan Center and the Laboratory sent care packages of New Mexico green chile, salsa, and beef jerky.

"Somebody sent me slippers," Borrego said, "a very nice comfort of home after wearing boots for many hours."

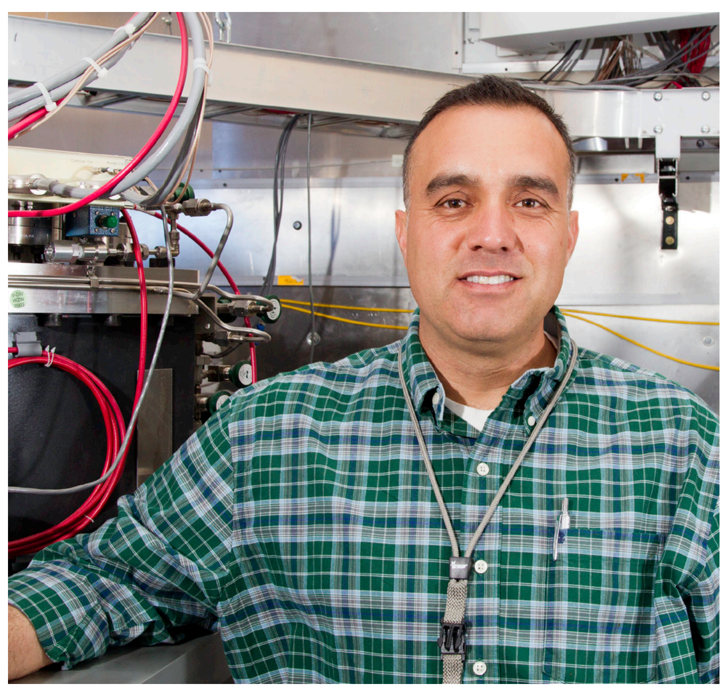
Fortunately, all 103 soldiers of the 1115th Transportation Company of the New Mexico Army National Guard returned home to their families in 2005.

Borrego said he found it reassuring to still have the job he loved at the Lujan Center. He is 1 of 2 technicians for 12 scientific instruments at the national user facility. If something breaks down or needs on-the-spot fabrication on the beam lines, he must react promptly, even if it's at 2 a.m. "It's my job to see that every user and every scientist at the Lujan Center gets a positive experience from a mechanical perspective," he said.

When he enlisted in the U.S. Army in 1991, he was a seasonal construction worker seeking steady work with health benefits for his young family. Borrego, who received a Combat Action Badge and other awards from his Iraq tour, is now a 1115th Transportation Company first sergeant, overseeing operations and training for 126 soldiers in the Taos-based unit. He performs two weeks of annual National Guard training and responds to federal and state emergencies. During the Las Conchas Fire, for instance, his unit spent two weeks providing security in Los Alamos by assisting local police and fire departments.

Whenever Borrego is on military leave, his Lujan Center colleagues step in, ensuring tasks get done and maintenance operations stay on schedule.

Now eyeing military retirement, Borrego is glad Los Alamos National Laboratory received recognition for what it has done for him and all employees in the National Guard or U.S. Army Reserve. Nearly 900 Laboratory workers have military affiliations. "I want to make sure everyone knows the Lab is a strong supporter of our civilian soldiers," Borrego said. "Without the Laboratory's strong support, we cannot do our jobs and fulfill our obligations in the military effectively."



Eric Brown *Charting clear passages for physics research around the globe*

Early in his career, Eric Brown measured his productivity as a scientist by publishing a peer-reviewed paper nearly every month. During a two-year change-of-station assignment at the Pentagon, however, he discovered satisfaction in the planning and program execution that enables big science. When he returned to Los Alamos National Laboratory in 2010 he sought a balance.

Now, as the new group leader for Neutron Science & Technology (P-23), Brown said he feels prepared to lead a crew of 90 and guide its broad sweep of physics, which ranges from dark matter detection to applied weapons experiments. “I continue to be excited and amazed by the breadth and depth of the people, science, and mission of the group,” said Brown, who previously served as a P-23 deputy group leader.

“Eric has an in-depth understanding of the work conducted within P-23 and has strong connections to the national and international dynamic materials community,” said Physics Division Leader Doug Fulton in announcing Brown’s new role.

During nine months in 2011 as acting group leader, Brown gained a deeper understanding of the P-23 teams, the collaborators, and the science. He said the group is unlike any other in Physics Division because of the large amount of off-site work, both across the United States and abroad: “It is not uncommon for two-thirds of staff to be on the road.”

P-23 is on a solid course scientifically and financially, with a full load of funded projects, according to Brown. He predicts no sharp turns, but he hopes to make P-23’s research more visible. For instance, Brown wants to create opportunities for scientific staff members to talk to U.S. Department of Energy decision-makers in person.

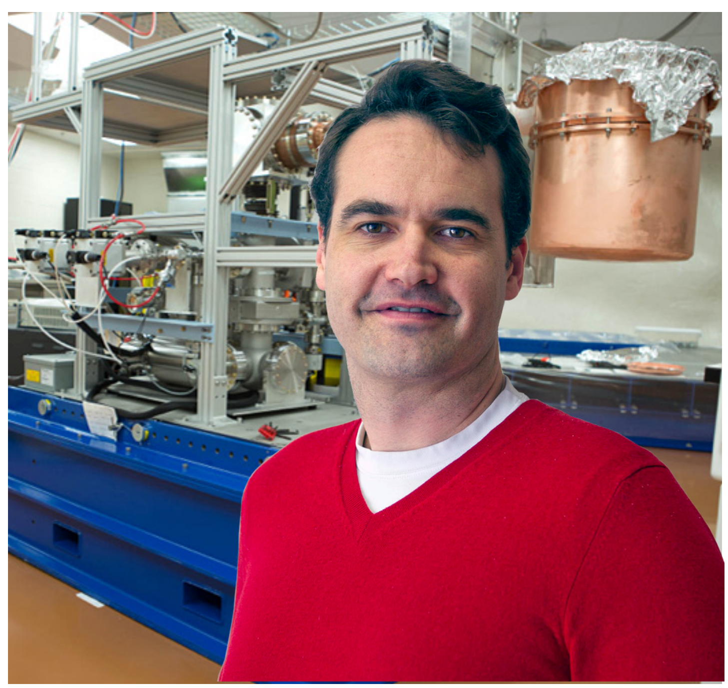
Brown grasps the challenges both sides face, having acquired first-hand knowledge as a program manager for the Laboratory’s Associate Directorate for Weapons, an action officer for the NNSA Science Campaign and the Inertial Confinement Fusion program, and a scientific advisor for the Office of the Undersecretary of Defense at the Pentagon.

To keep P-23’s scientific reputation thriving, Brown encourages staff working on applied programs to keep one foot in classified weapons research and the other foot in publishable basic research, as he did. Peer review and outside collaborations help researchers grow and stay “on the forefront of the science we do,” he said.

P-23 group leader is “an exciting post to be in,” Brown said, “because we have a rich pool of new scientific discoveries that are just beyond our fingertips right now.”

On the group’s weapons program side, the Gemini experiment has been “an important success,” he said, for studying the behavior of plutonium. P-23 researchers are now taking the scientific lead in a new weapons experimental program at U1a in Nevada. With the National Ignition Campaign concluding last year, P-23 continues to work at the National Ignition Facility and make significant contributions to the Inertial Confinement Fusion program. “There is a future to be had there; we’re working to define our role,” Brown said. In fundamental research, the High-Altitude Water Cherenkov Gamma-Ray Observatory (HAWC), the Majorana underground neutrino experiment, and the MiniCLEAN dark matter experiment will soon be collecting data, enabling new discoveries in astrophysics and particle physics.

For Matter-Radiation Interactions in Extremes (MaRIE), the Laboratory’s proposed experimental facility for the discovery and design of advanced materials, P-23 scientists will help define the physics behind some of its key capabilities and develop first experiments. “I spent time in the materials division here, so (MaRIE’s mission) is something I resonate with,” said Brown, who has a PhD in theoretical and applied mechanics from the University of Illinois at Urbana-Champaign. Brown joined the Laboratory in 2003 as a Director’s Funded Postdoctoral Fellow in the Materials Science and Technology Division.



Yates Coulter *Contributing to record-setting successes at the magnet lab*

Yates Coulter knew he had an opportunity to reinvent himself. Given the impending restructuring of the Superconductivity Technology Center, joining the National High Magnetic Field Laboratory's Pulsed Field Facility made sense. Since 1995, the research technologist had collaborated with the generator operations team there.

Now, as the team's newest member, Coulter is something of a lion tamer; his job—to help keep the mag lab's mammoth generator in tip-top shape. The 1,428-megawatt turbo generator has a long history of providing power for high-field pulsed magnets at Los Alamos. When it first rolled into town in 1984 on a convoy of trucks, Coulter, with a bachelor's degree in physics from Syracuse University, was working as a materials handler, performing surface science at the Laboratory's Plutonium Facility. The generator's arrival was an impressive sight he said he'll never forget.

"I never imagined I would be working at the National High Magnetic Field Laboratory, running high-field pulses," said Coulter, of Condensed Matter and Magnet Science (MPA-CMMS).

Coulter spent the past 25 years developing characterization systems for superconductivity, publishing in journals, and building three labs. He has earned a reputation for working on tough experimental projects, even attempting to make superconductors in zero gravity with NASA astronaut and former Los Alamos scientist Don Pettit on two missions flown out of Johnson Space Center.

Though focusing on one massive magnet system is new for Coulter, he understands the diverse technology employed at the Pulsed Field Facility. Years ago, he designed and built a small version of the magnet lab in the Materials Science Complex, where condensed matter physics research continues today.

Coulter also built his own magnet systems, just as the Pulsed Field Facility does. Further, he grasps the stakes—improper operation can destroy generators or magnets in one pulse.

"I'm so grateful. Yates makes my job a lot easier," said Pulsed Field Facility Director Chuck Mielke. "He has absolutely changed the effectiveness of the crew that operates this generator. He just climbed on board and really made a difference."

The team now produces magnetic pulsed fields with greater ease, flexibility, and reliability for users who come to Los Alamos from around the world to perform experiments on the facility's unique equipment. "He's getting things changed that really matter," Mielke said.

What's more, tighter operations contributed to a banner year of research. In March 2012, Pulsed Field Facility scientists set a world record of 100.75 tesla, the strongest magnetic field produced nondestructively.

Better performance leads to better science

Weighing 450 tons, the generator sprawls horizontally in a custom-made building. In a control room, Coulter and the rest of the team monitor, in real time, data that the generator spews through thousands of signals.

After Coulter brought a new perspective on process control from his superconductivity experience, the team recently outfitted the beast with new instruments for predicting machine performance and magnet health. They chart oil temperature, cooling water conductivity, and other vital signs–nonstop. The team mends the generator's aging parts. They even have a small weather station to estimate magnetic resistance.

Coulter's high aspirations–and his competitive nature–are visible on his hard hat. In red and blue marker he tallies each magnetic pulse he fires himself: 53 at 60 tesla and 8 at 100 tesla. "Running a pulse is a manual skill," Coulter explained. "It's not just a pushbutton operation. You have to get the timing just right to create reproducible magnetic fields."

He aims to hit it right every time. "Reproducible fields make for reproducible science," Coulter said.

John Dunwoody *Engineering a new R&D lab for nuclear fuels*

When John Dunwoody gives tours of the 1,200-square-foot Fuels Research Laboratory (FRL), he covers all the angles. That's because he helped build it, maintains its operations, and runs experiments on its unrivaled equipment. "What's exciting is that we have this facility where collaborators can come in and work with these nuclear materials," said Dunwoody, an R&D engineer for the specialized nuclear fuel research team in Polymers & Coatings (MST-7). "Out of all the national laboratories, we are the only one with this complete suite of instruments and capabilities."

For nuclear energy researchers, straightforward access to the lab's five glove boxes is a real plus, he said, noting the facility is accessible to national and international collaborators as well as Los Alamos researchers and students.

The new lab, funded by the U.S. Department of Energy's Office of Nuclear Energy (DOE-NE), opened on a limited scale in February 2012 and is now fully operational.

Scientists have come to study the moisture effects on fuels and their cladding systems. As envisioned by Ken McClellan (Materials Science in Radiation & Dynamic Extremes, MST-8) and Principal Investigator Andrew T. Nelson (MST-7), the lab will serve researchers who want to quickly explore oxide fuels. McClellan said FRL is "the best equipped laboratory that I know of for the development of uranium and thorium-based nuclear fuels." Many users are doing projects for DOE-NE's Advanced Fuels Campaign, which is charged with evaluating and developing advanced nuclear fuel technologies.

After training users, Dunwoody helps prepare fuel pellet samples and run experiments, among other duties. "We do not qualify nuclear fuels, but what we do is give researchers the opportunity to investigate the thermophysical properties (i.e., characteristics that affect the transfer and storage of heat) of the fuels and materials of interest," Dunwoody said. "We give them a starting point for modeling and simulation." For example, understanding how oxide fuels crack and swell is important for predicting fuel efficiency and fuel pin longevity, he said.

"We're trying to dial in our own specific stoichiometry (in this case, the excess oxygen allowable in uranium dioxide) and then measure those effects," Dunwoody said. Excess oxygen affects fuel properties and performance during operation.

Beyond nuclear materials, the lab also is conducive to the study of metal alloys and inert oxides. "We've done some great stuff here," Dunwoody said.

Dunwoody, who in 2011 earned a master's degree in nuclear engineering from the University of New Mexico, has been a lead technician on a number of actinide fuel projects at the Laboratory since 2003.

"John was critical to the establishment of the Fuels Research Lab and is now key to the safe, efficient, and productive operation of the FRL," McClellan said. "He was the ideal person for me to turn to as the lead on the lab setup," he added, citing Dunwoody's combination of expertise in quality assurance policies and radioactive material operations, along with his years of hands-on experimental experience in ceramic nuclear fuel research and development.

Dunwoody spends the bulk of his time ensuring the lab operates safely for researchers, while reserving time to conduct his own research, too. Wearing a disposable lab coat, he admitted he is rather "obsessive" about radiological controls and sample management. And the lab complies with the Green is Clean program, a Laboratory initiative aimed at reducing low-level radiological waste.

"I have a small pond, and I'm happy in it," Dunwoody said.

Fernando Garzon *Sensing the future of advanced fuel options*

Searching for cleaner, more efficient ways to power the world, materials scientist Fernando Garzon experiments in his lab much like a chef does in a test kitchen, by trying different ingredients and working from scratch. "Many of the world's energy problems are materials problems," said Garzon, who leads a small team in Sensors & Electrochemical Devices (MPA-11) focused on solving such challenges.

Ceramic gas sensors are Garzon's specialty. Ideal for harsh, gaseous environments—such as diesel and gasoline engines in vehicles, gas turbines, and small stationary power plants—the sensors he helped invent are versatile enough to work in other environments too, such as hydrogen fuel cell-powered vehicles and remote air pollution monitoring stations. When modified, the sensors can detect explosives. Last year at a sensors workshop in Washington, D.C., Energy Secretary Steven Chu cited the invention as an example of Department of Energy scientists delivering necessary technology to the nation's manufacturing industry.

Affordable and small enough to fit in a vehicle's tailpipe, these new sensors could revolutionize the transportation industry and reduce America's dependence on foreign oil, according to Garzon. "We're talking every vehicle in the world, potentially," he said. The multitasking sensors monitor tailpipe and fuel emissions; they also provide information for advanced feedback control of internal combustion engines, which current zirconia sensors cannot do.

"These are actually made like little ravioli," Garzon said, pointing to prototypes on a table in his lab. He hand-cuts green ceramic sheets, laminates them, and assembles layers of electronic ceramics. Then he bakes the sensing strips in a furnace. "The magic is to get all (the elements) to fuse together to form the structure you intended to make," he said. Now, the researchers must leap over "the great gulf," he said, where a lot of inventions falter, by affordably transferring a device handmade in the lab to mass production. Garzon's team, and collaborators at ESL ElectroScience in Pennsylvania, are working to automate the process. Together, they have produced working commercial prototypes, which meet sensitivity requirements for emissions control in light-duty diesel engines.

Garzon's theories about the underlying electrochemical processes of ceramic gas sensors are important guideposts as designs and materials are chosen for vehicles of the future, said Bob Glass, Lawrence Livermore National Laboratory's hydrogen program leader. "In this area of solid-state electrochemistry, Fernando has been a pioneer," Glass said.

Finding materials solutions to energy challenges

Influenced by his cardiothoracic surgeon father, who performed the first heart-valve replacements, Garzon considered following in his footsteps. Instead, with the 1970s energy crisis looming, he was motivated to pursue a career in materials science.

After earning his PhD in materials science and engineering from the University of Pennsylvania, Garzon became a Los Alamos postdoctoral researcher in 1988—working for prominent solid-state materials expert Ian Raistrick—and a Laboratory staff member in 1989.

And through the years, Garzon said, exceptional researchers, including co-investigators Eric Brosha and Rangachary Mukundan, have continued to enrich his work here. "The ability to attract and retain world-class scientists and foster collaborative research—these are Los Alamos's greatest assets to the nation," he said.

The recipient of the 2012 Los Alamos National Laboratory's Fellows Leadership Prize, Garzon also is a fellow of the Electrochemical Society, a past president, and past chair of its Board of Directors.

Gary Holladay *Taking action in working safely*

Gary Holladay of Accelerator Operations & Technology (AOT- OPS) had just started the Friday night shift when the letters “DPW” turned red on a status screen in the Central Control Room of the Los Alamos Neutron Science Center, indicating an equipment problem. Two neutron detectors had faulted electronically.

Holladay, the operations shift supervisor who runs the beam for the half-mile-long linear accelerator, jumped up to fix the problem. He drove across La Mesita Road and descended the steps to Lujan Center Experimental Room 1 (ER-1).

While plugging in a surge protector and checking connections, Holladay was unaware that his right knee, his right elbow, and his feet were brushing against a thin film of powder. On his way out, he ran his hands along the stair railings.

At that point, Holladay’s task in ER-1 was complete. He could have headed straight back to his workstation, but Holladay’s sound work practices are deeply ingrained.

On August 24, he stepped into the Blue Room’s radiation portal monitor, adjacent to ER-1, and the beeps rang out. Over the years, Holladay had never triggered a positive reading. Promptly and properly, he reported the issue. He also instructed the other accelerator operators to stay out of ER-1. “I was more concerned about my crew than the beam at that point,” he said.

Before routine radiation surveys in ER-1 were scheduled to take place, Holladay’s diligence and sound safety practices alerted Los Alamos National Laboratory to the inadvertent spread of technetium-99. The substance is a source of beta radiation—low-power, fast-moving electrons that can travel through several feet of air, but are generally stopped by clothing and skin. The on-site and off-site contamination posed no danger to the public, but the event shut down the Lujan Neutron Scattering Center for a considerable amount of time as the contamination was cleaned up.

In recognition of his conscientiousness, he received a handwritten note from NNSA Administrator Thomas D’Agostino thanking him for his “excellent work and safety practices,” plaudits from Laboratory Director Charlie McMillan during a meeting in his office, and a Laboratory Spot Award.

“I felt it was very important, especially in the immediate aftermath of the event, to ‘catch someone in the act of doing something right,’ ” said McMillan. “Had Gary not done what he did—in fact, what he always does—the contamination would have spread even further.”

The Laboratory is addressing the root causes of the event. Additionally, as part of the resumption process several radiological foot and hand monitors are now installed in ER-2, to be shared by both experimental halls.

So, why did Holladay use the whole body monitor when he was in the middle of solving a problem?

It was simply part of his routine and his tendency to err on the side of caution. Flip through the log book and you’ll see Holladay is one of only a few people who continued to “portal out” of ER-1 when exiting through the Blue Room, even though the requirement was lifted years ago. This sense of caution was instilled in Holladay in part by (now retired) crew chief Chuck Burns, who encouraged Holladay to self-monitor before heading back to his workstation.

“I’m religious about it,” Holladay said. “I look forward to the future, and I don’t want to make a mess anywhere.” Besides, he noted, the time it takes to prevent a mess is less than the time it takes to clean up one.

John Joyce *Up against a heavyweight trickster*

For materials scientist John Joyce plutonium is both an enigma and a source of inspiration. Joyce leads a small team in Condensed Matter & Magnet Science (MPA-CMMS) that probes the electronic structure of materials. The team fills a rare niche, using a measurement technique called photoemission to study plutonium. Worldwide, the only researchers doing comparable studies on plutonium, he said, are in Karlsruhe, Germany.

Los Alamos scientists have been on a quest to comprehend plutonium's unusual properties ever since nuclear chemist Glenn Seaborg helped synthesize it in 1940. So far they've unraveled only a few of its secrets.

A trickster and a shape-shifter, the heavyweight metal changes its crystal structure six different ways, more than any other element in the periodic table. Depending on temperature, it can be as fragile as a ceramic, as malleable as a plastic, or as strong as cast iron. In powder form it can spontaneously burst into flames and vanish into thin air. Seaborg declared plutonium "the first realization of the alchemist's dream of large-scale transmutation . . . the first synthetic element to be seen by man." It's an enigma of our making—that's the irony.

For 16 years, Joyce hammered away at decades-old issues surrounding plutonium metals and oxides. Now, a host of new questions are brewing. "There are many unsolved problems in plutonium science, from understanding superconductivity in plutonium compounds, to hybridization in plutonium oxide bonding, to hydrogen in the plutonium metal stockpile," he said. The nation's stockpile of nuclear weapons, for instance, contains more hydrogen than originally believed. By understanding how plutonium behaves with other materials and how it ages, scientists will better understand what must be done to preserve nuclear weapons and manage plutonium in storage.

Finding reward in unique research

After steeping himself in photoemission research as a doctoral student at the University of Wisconsin-Madison, Joyce joined Los Alamos in 1990. Alongside the late Al Arko, who launched the photoemission program, Joyce and Kevin Graham designed and built instruments for a new lab. The Laser Plasma Light Source (LPLS) was certified for plutonium operations in 1996. Now principal investigator on the project, Joyce is the recipient of a Los Alamos Distinguished Performance Award and two Los Alamos Achievement Awards for his leadership of the program.

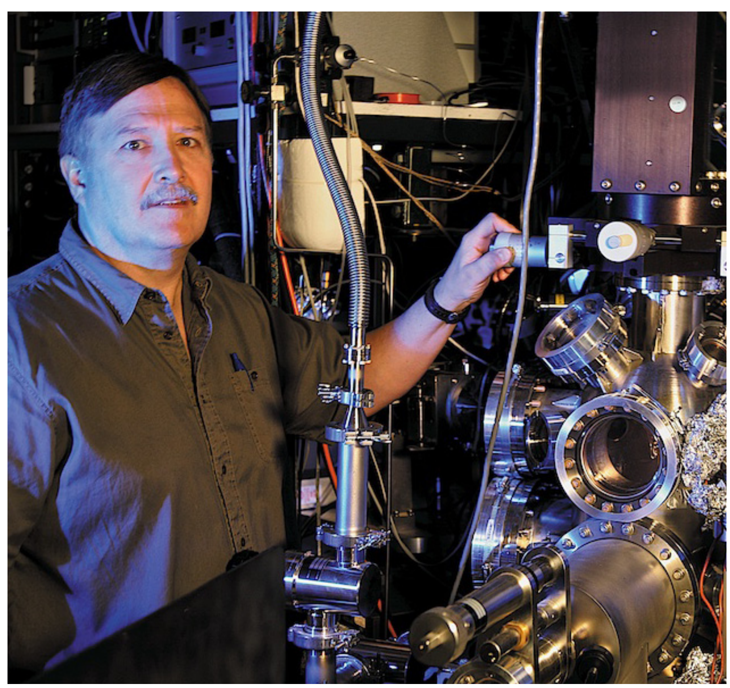
Joyce stands out "as one of those scientists who value hard work and merit," his colleague Tomasz Durakiewicz said. Durakiewicz, who joined the program in 2000, played a major role in upgrading all the lab's components and expanding the range of experiments the lab is used for, Joyce noted.

Though tucked away in a nondescript building, LPLS is nothing short of a treasure. Yellow doors and a traffic-light-like signal alert entrants to the use of laser radiation inside. Equipped nearly to the ceiling with special instruments, the lab houses the world's only angle-resolved photoemission spectroscopy instrument dedicated to transuranic materials, allowing scientists to investigate a material's electronic structure, in energy and momentum. The lab also boasts the world's only tunable light source for transuranic research.

"There's something rewarding about doing research that's unique in the world, measuring something no one else can measure, writing about it, talking about it," said Joyce.

Joyce's team used to spend as many as 12 weeks of the year at the nation's synchrotrons, scouring the electronic structure of a broad smattering of actinides. With the heightened emphasis on plutonium, however, the team spends more time at LPLS. Synchrotrons don't allow photoemission experiments on plutonium samples—the samples can't be encapsulated, thereby posing the costly risk of storage ring contamination—so LPLS is an inexpensive tool that gets the job done, Joyce said.

For Joyce, the Laser Plasma Light Source is also a refuge. If he feels flattened by fundraising and paperwork, he said he ducks into his lab and comes out refreshed.



Jon Kapustinsky *Chasing the waves of particle physics*

Researchers in the field of particle physics sometimes compare themselves to surfer dudes. "Wherever the next big wave is, that's where we go," said Jon Kapustinsky, Neutron Science and Technology (P-23) acting group leader.

At Los Alamos, where steep canyons overshadow the sleepy Rio Grande, Kapustinsky caught his first "wave" 32 years ago. To Canada, Switzerland, and other national labs he has chased "the most exciting physics opportunities as they emerged at particle accelerators," he said.

Kapustinsky now has another formidable wave to catch. He is pulling together a team to design an advanced x-ray detector for the proposed Matter-Radiation Interactions in Extremes (MaRIE) experimental facility, which scientists will use to discover and design advanced materials. His team must advance the current technology of imaging detectors to meet the extraordinary temporal and spatial requirements imposed by MaRIE experiments.

Kapustinsky, who until recently divided his time between scientific research and Subatomic Physics (P-25) deputy group leader responsibilities, has designed and operated increasingly complex detectors to probe the most elemental subatomic scales. For example, silicon-based experiments that once involved 10,000 individual detection channels now require more than 1 million channels and collaborative teams have evolved from a handful of members to more than 600.

Internationally known for his expertise in silicon detector technology and his understanding of radiation damage effects in detectors and electronics, Kapustinsky was deputy project leader and subsystem manager for sensors and electronics in the $5 million Forward Silicon Vertex Tracker (FVTX) construction project at Brookhaven National Laboratory. Part of the Pioneering High Energy Nuclear Interaction Experiment (PHENIX) upgrade, FVTX aids in the search for and study of quark-gluon plasma, the state of the universe right after the Big Bang, before particles cooled and coalesced into matter.

"Jon has a quiet way of leading that is very effective," said P-25 Group Leader W. Scott Wilburn. "He knows what it takes to make a scientific project succeed and is able to steer a diverse team of people toward success. Whether he is participating as a researcher or a reviewer, he will get to the bottom of any problem."

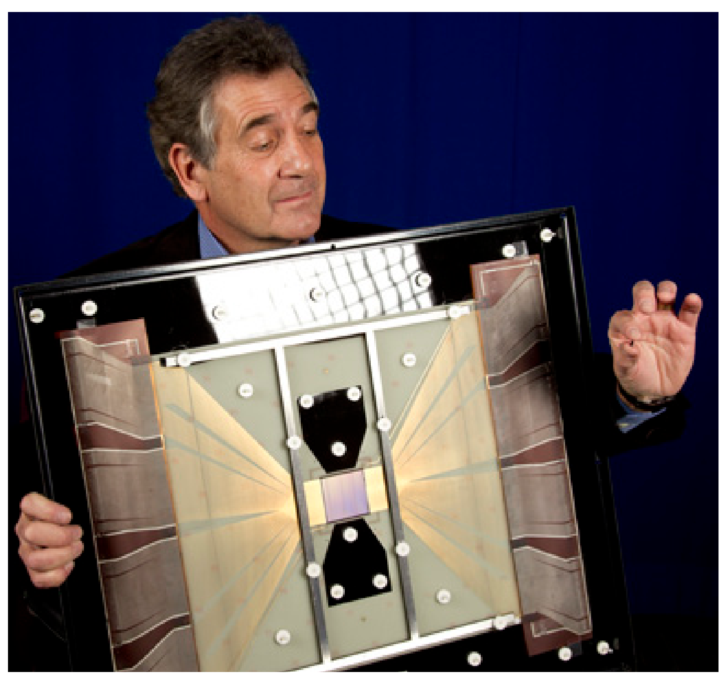
Intellectual curiosity leads to scientific passion

A New Jersey native, Kapustinsky was drawn to New Mexico while studying the writings of English novelist D.H. Lawrence at England's Wroxton College. Lawrence lived the latter part of his life in Taos County. Kapustinsky discovered LANL after he moved here. It was his other interests—electronics, applied mathematics, and physics—that eventually brought him, in 1980, to the Laboratory's Physics Division. "The breadth of top-rate research that is performed at the Lab is astounding," Kapustinsky said. "One can take advantage of it from the perspective of intellectual curiosity, or one might even discover a scientific passion that is different from the road they started down."

He chiseled out his niche when his mentor said, in reference to a proposed experimental program, "If you want to take this on, you could become one of the world experts on silicon detectors in experimental physics."

And that's exactly how it went. The silicon detectors he built for Fermilab, the high-energy physics laboratory in Illinois, survived the severe radiation environment and produced valuable data, leading to widely cited papers, invited talks, and international "big science" projects. As Los Alamos project leader of the Silicon Microstrip Detector for the L3 high-energy physics experiment at CERN, the European Organization for Nuclear Research, he oversaw the assembly and installation of a 70,000-channel silicon tracker. At Los Alamos, he designed silicon strip detectors and a novel silicon pad detector for the PHENIX Multiplicity Vertex Detector.

Now that same niche could launch the next big wave in Kapustinsky's career. Silicon pixels, he said, is one path he will pursue on the MaRIE project.



Ray Leeper *Accelerating plasma physics*

Imagine the year is 2018. The Los Alamos National Laboratory's Plasma Physics group (P-24) continues to be one of the most productive and influential physics organizations in the nation. Through achievements in weapons physics, inertial confinement fusion, fusion energy science, short-pulse laser work, as well as diagnostic development and engineering, the group has secured a strong and stable budget. The sky is the limit.

Looking to the near future, this is the destination new P-24 Group Leader Ray Leeper has in mind for his 50-some scientists. To get there, Leeper plans to expand the group's leadership role and budget in three areas: stockpile stewardship science, fundamental science, and fusion energy science. "P-24 staff members are some of the very best in the world in their chosen fields," he said. "However, to take advantage of this talent they must be funded at a level commensurate with the potential of what they are capable of doing."

As a successful physicist for almost four decades and a licensed commercial pilot, Leeper has experienced the thrill of charting "highways in the sky." His vision for P-24 flight paths includes

- Expanding participation in national high energy density (HED) physics and fusion energy science programs;
- Providing leadership to the weapons physics, inertial confinement fusion, short pulse laser research, fundamental science, and fusion energy science programs from a perspective of reality and what the nation needs;
- Applying P-24's people and resources to issues that play to P-24's technological strengths;
- Establishing an experimental program that ensures that the Laboratory's national mission in weapons science can be carried out in the near term and the future; and
- Building a strategy to recruit the best and brightest staff members and technologists to the group.

In introducing Leeper, Physics Division Leader Doug Fulton said, "He has an in-depth understanding of the work conducted within P-24, has strong connections to the national and international HED physics community, and is well known to many of us in Physics Division."

Since the 1990s, Leeper has teamed up with Los Alamos scientists on projects from coast to coast. At Sandia National Laboratories, where he was given the moniker "Cosmic" Ray, he led collaborations in inertial fusion and high energy density physics, performing experiments at Sandia, Lawrence Livermore National Laboratory, and University of Rochester facilities.

Today, Leeper is part of the Fusion Energy Sciences Advisory Committee that gives advice to the U.S. Department of Energy's Fusion Energy Sciences Office. "Serving on this committee gives me knowledge and perspective on the national magnetic fusion program and that helps me manage P-24 programs in this area," he said. Leeper also served on an external panel that reviewed the National Ignition Campaign (NIC). When NIC came to an end in 2012, Leeper contributed to the final report, which addressed obstacles to ignition and priorities for research.

Drawing on his keen bird's-eye view, Leeper hopes to prime P-24 physicists for bigger roles. "I have fantastic respect for this institution," he said. "When this (job) arose as an opportunity, I jumped at it because I think Los Alamos should have a larger role in the national high energy density physics program, and I would like to lead that effort."

After receiving a PhD in physics in 1975 from Iowa State University, Leeper became a staff scientist in Sandia's inertial fusion program. In 1986, he became manager of Sandia's Diagnostics and Target Physics department. In 2003, his group earned a NOVA Award from Lockheed Martin, Sandia's operating contractor, for generating the first thermonuclear neutrons on Sandia's Z machine, a step toward achieving controlled nuclear fusion. Lockheed Martin's highest honor recognizes outstanding contributions to the corporation's mission and business objectives.

Tom Lienert *Stoking welding science to greater heights*

During the past 30 years, Tom Lienert has made a distinct mark on the science of welding and joining. He has developed new methods for joining metals and solved stubborn technical challenges on behalf of the nation's defense and global security programs.

"Tom is truly one of the most impressive welding researchers I have ever met," said Jerry Gould, who supervised Lienert early in his career at Ohio's Edison Welding Institute. Gould, among others, supported Lienert's nomination as a 2012 American Welding Society Fellow. "He has been a strong advocate of the welding sciences at every level, from foundational understanding to top-level research, to education, to technical outreach." Lienert was also recently named a 2013 ASM International Fellow.

Lienert is a research-and-development engineer with Materials Technology-Metallurgy (MST-6), which specializes in plutonium and uranium, as well as common engineering alloys. He tests his theories inside Sigma's massive welding shop, which offers an impressive array of welding machines, including laser welders, electron beam welders, and friction welding machines. While designing experiments for research technicians to run here, he draws from his doctorate in materials science and engineering, intertwining aspects of metallurgy, physics, chemistry, and heat transfer. Given the national security mission of Los Alamos, far-reaching solutions often come out of seemingly simple technical challenges. With colleagues at Los Alamos, the Y-12 National Security Complex in Tennessee, and the Pantex Plant in Texas, Lienert helped determine why a laser weld was cracking and devised a laser-alloying method to prevent cracking in the newly formed weld. The patented solution, a valveless laser processing technique, was so novel that *R&D Magazine* lauded it as one of the top 100 innovations in 2012.

The solution, using a laser that can remotely drill and reweld a hermetically sealed container, is attractive to the private manufacturing industry because of its cost-savings potential. But the primary purpose of the technology is for scientists and engineers who study the aging processes and overall reliability of the nuclear weapons stockpile. Besides saving production costs, the technique is expected to reduce worker exposure to hazardous materials.

In his latest project, Lienert and colleagues are working to develop a procedure for using electron beam welding to fabricate aluminum-clad/uranium alloy fuel plates. The U.S. Department of Energy is looking for solutions that would allow research reactors to burn low-enriched uranium fuel instead of highly enriched uranium fuel. The aim is to minimize or eliminate fuels that can be used in weapons of mass destruction. "When we get this process to work," Lienert said, "it will save the fuel plate manufacturer over $1 million per year in production and labor costs."

How Lienert found his passion

Surrounded by manufacturing smokestacks in his hometown of Buffalo, New York, Lienert pictured a career in the automobile industry and earned an associate's degree in materials science technology at the local community college. However, the gas crisis paralyzed the region's economy, spurring him west to become a welding research technician at Sandia National Laboratories in Albuquerque. After spending the next decade under welding metallurgist Mike Cieslak at Sandia, Lienert concluded "laser welding was cool" and headed to graduate school. At The Ohio State University he characterized inertia-friction welds on aluminum metal matrix composites (Al-MMCs) for his master's thesis, and he studied the microstructural evolution in laser and electron beam welds on Al-MMCs for his dissertation. At his first job, with Edison Welding Institute, he gained an international reputation for his advancement of friction stir welding of high temperature materials. Laser welding returned as his focus when Lienert joined Los Alamos in 2002. "Laser welding plays a key role in Los Alamos National Laboratory production activities," he said. He now is managing a project to modernize lasers at the Plutonium Facility.

Throughout his career, Lienert has made a point to shepherd others into the field, which suffers from a chronic shortage of workers. In addition to serving as director-at-large on the American Welding Society's board of directors, he has invested years on the education committee and education scholarship committee. "In the last several decades, welding has evolved into an interdisciplinary activity; it requires synthesizing knowledge from many disciplines and incorporating the most advanced tools of basic and applied sciences," Lienert said. "It's not an art," he emphasized. "It's a science."

MPA office administrators *Supporting scientific discovery*

Although their names don't appear on papers published in scientific journals, it's a proven fact that the office administrators of Materials Physics & Applications (MPA) contribute greatly to the organization's ability to produce high-impact research. Across the Laboratory campus, in 5 groups, including 2 national user facilities, they support more than 400 employees and countless visitors. In the old days "admins" were on their computers transcribing handwritten notes—with detailed equations and arcane symbols—into scientific papers, recalled Susan Duran (MPA-DO). Today admins play a different role: freeing up time for researchers to focus on their experiments and prepare their own papers. They step up to assist staff members, postdoctoral researchers, and students in any way needed—from routine matters of safety and security, travel, time and effort, property, personnel, and purchasing, to urgent requests, such as planning, in a week's time, a manager's last-minute mandatory trip to Russia, a process which usually takes two months to complete. Before joining Los Alamos National Laboratory, many of MPA's administrators worked in other kinds of offices—at schools, nonprofits, State of New Mexico departments—and even a casino. Read on to discover more.

Susan Duran

Materials Physics and Applications, MPA-DO

Great experiences
The Lab has been very good to me. I started off as a clerk in the Personnel File Room and grew quickly through a succession of great managers and job changes.

Places to go, things to do, people to see
Throughout my career I've been able to do some really interesting things. I've "witnessed" a shot at Ancho Canyon, seen where HE is machined, watched some of the big machine tools in action, and been responsible for preparing for and pulling off some large and important meetings.

On the job
The most fun job I had was working for David Moore, a division leader in the Public Affairs Division. He had, earlier in his career, been a photographer for *National Geographic*. I had the opportunity to meet and interact with foreign dignitaries, senators, high-level military officers, Nobel Prize winners, etc. I was also able to "star" in a couple of short videos, one on how to view an eclipse and another on an alternate fuel car developed at the Laboratory.

A tech-at-heart
In my dream world at the Lab, I'd like to move into a technician role or do something artsy, perhaps with CAD or something similar. Before MST split, one of the MST-7 secretaries moved into a position where she uses a cat whisker to apply epoxy to attach a shield to a target.

I was one of the relatively few children raised in Los Alamos whose father didn't work at the Laboratory. My interests in high school focused on business and art-related classes so I took the minimum math and science required for graduation. While working for MST, however, I was very pleasantly surprised seeing the excitement people have for what they do here and my curiosity was piqued. I saw a group leader with toys on his conference table and when I mentioned them, he jumped up and showed me some of the reasons for them and his excitement was contagious. Also, shortly after Starbucks opened, I walked into a deputy division leader's office just as he took his fancy carbonated Starbucks drink in a clear cup with a lid, turned it upside down, slammed it on his desk, and stared at the bubbles. Surprised, I watched for a couple of seconds to see if there was a reason for this odd behavior. Then, without lifting his gaze, he said, "There are people who study these bubbles!" Who would have thought?

That's why it's so important that our scientists, particularly female scientists, volunteer and interact with young school children to get them interested in science and as they get older, to let them know what kinds of careers are out there and what fun things they can do with their lives. As a single parent with no science background, I'd really appreciate that kind of opportunity for my child.

Linda Chavez

Center for Integrated Nanotechnologies, MPA-CINT

From knowledge services to nanomaterials
In 2002, I started as a contractor for the Research Library as the group office administrator, then a few months later applied for a full-time position with MPA-CINT and got it.

Previous engagement
I was office manager for Saint Francis Academy, a behavioral health organization that offered multiple services to children, youth, and families.

Meet and greet
I truly enjoy my job as the visit facilitator for CINT. I meet wonderful folks from all over the world who come to our facility to conduct scientific research. Knowing that I have contributed in making their visit successful from beginning

to end, bringing forward a successful collaboration between LANL and their institution, brings a smile to my face. Many of our incoming users and visitors are foreign nationals. As the user visit facilitator, I oversee our Center's visitor program and manage all aspects of the process, such as scheduling, preparing visitor or guest agreements tailored to the specific visit requirements, coordinating travel arrangements, and coordinating and scheduling visitor training to ensure compliance and safe conduct of work.

Vanessa Gonzales

Center for Integrated Nanotechnologies, MPA-CINT

"CINT-er" since 2011
People who work at the Laboratory seem to be very happy people because Los Alamos National Laboratory takes care of its employees.

Previous know-how
I was a Behavioral Management Specialist with TeamBuilders Counseling Services, Inc., helping children learn how to live in their community with their social or emotional disorder.

Daily challenges
The workload is always a challenge. Your priorities shift very quickly. I typically have 30 items on my list that I need to get done, and as I mark off one item on the list two more items get added on. I'm learning how to prioritize my work so that one item does not fall off my to-do list or an individual's request does not get pushed back too far.

Juanita Armiijo

Condensed Matter and Magnet Science, MPA-CMMS

Now…
Joined the Laboratory in 1972, looking for a stable, permanent position with more pay; worked in Theoretical Division for 27 years before coming to MST-10, now reorganized as MPA-CMMS.

… and then
Department secretary for New Mexico Department of Transportation.

Career advice
Get an education! Be punctual, responsible, and be serious about your contributions to the organization. We all have the same mission.

Rewarding experiences
I take pride in ensuring the MPA-CMMS group office is run in a professional manner. I work closely with staff and line management to develop, assign, and monitor relevant training curricula for our incoming students, postdocs, and long-term visitors/affiliates. I see that the visitor and foreign national program for our Materials Science Complex continues to be a success. While working in T Division, I taught an equation typing class for anyone who wanted to learn how to type technical documents with equations. I prepared technical and scientific documents from hand-written documents, including classified and unclassified Los Alamos reports, assisted in preparing many thesis documents, and was instrumental in putting together the *Proceedings for the 14th Annual National Conference of the National Organization of Black Chemists and Chemical Engineers*. While working at STB (Science and Technology Base program office), I was part of the team who worked on and beta tested the foreign travel system (currently the legacy travel system) before it went online and was made available to the users.

Julie T. Gallegos

Condensed Matter and Magnet Science, MPA-CMMS

Word of mouth
Joined the Laboratory in 1989 as an undergraduate student. I had heard for years that LANL was the best place to work in terms of pay scale, benefits, and career opportunities.

Previous know-how
High school secretary at Mesa Vista High School in Ojo Caliente, New Mexico.

MVC! Most valuable contribution
A willingness to go the extra mile to achieve my objectives, which have always been to learn as much as I could so as to offload as much administrative work as possible for the managers and staff whom I support.

MPA! Most proud accomplishment
Being able to adapt to ever-changing LANL systems and processes and doing it in a way that the changes are seamless to the staff I support. The changes in administrative systems are always a challenge because the work doesn't stop while you're learning a new system or process.

A positive effect
Cecilia Olivas, who was an Office Procedures trainer when I started working at LANL, had a very positive impact on me. She encouraged people with little or no LANL work experience to be positive and self-confident. She said, "You can

go as far as you want to go at LANL; the opportunities are there if you look for them and work toward them."

Her words of advice
Take pride in your work, have a positive attitude and work ethic, and follow through on all of your work. The job you do for your employer says everything about you as a person.

Angie Willow

Condensed Matter and Magnet Science, MPA-CMMS

Taste traveler
Since I joined the Laboratory in 1992, I have met visitors from many different cultures. Lots of the visitors bring different treats, the best being a green tea Kit Kat (candy bar) from China.

Let's make a deal
Previous job: I worked as a table games dealer (craps, black jack, roulette, and poker) in the casino industry.

Mentor a must
Julie Gallegos is our professional staff assistant. We work as a team for the numerous staff, students, and visitors that visit the Pulsed Field Facility at the National High Magnetic Field Laboratory. Julie has always been very professional and taught me above all to remain calm and tackle each job as it comes. She's my inspiration to continue with my education.

Diplomat
Since most of our visitors are from different countries and are not familiar with LANL, we do what we can to make them more comfortable with their surroundings, taking the time to answer all their questions. We had one really cool student from Scotland here for a year, and since he had never driven a vehicle in his entire life he rode a bicycle everywhere. I made it a point to offer him rides home, especially in the winter months. He loved to talk about Scotland—and that would be one place I would love to hop on a plane and visit.

Julie A. Garcia

Materials Synthesis and Integrated Devices, MPA-MSID

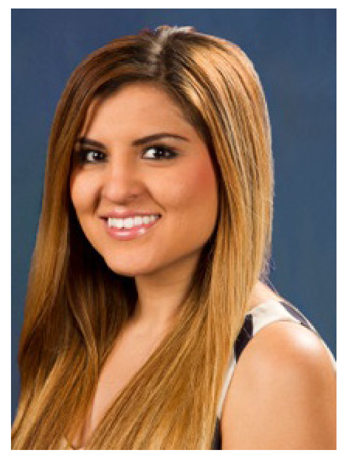
Technically speaking…
Started in 2006 as an administrative assistant for the Office of Laboratory Counsel, Litigation Management group, then switched to MPA-MSID to experience the technical side of Los Alamos.

Legitimate experience
A legal secretary and paralegal for about 16 years in the private sector.

A few of my favorite things
I have learned so much since coming to MPA-MSID, and I have met so many wonderful and diverse people. I enjoy helping out my group with everything administrative, while at the same time getting a glimpse into the world of chemistry and the great contributions to the research, science, and development that takes place here at LANL.

It could only have gotten better
One of my most memorable experiences was coming to my interview for my current position at TA-48, Bldg. 1 and trying to find my way through the maze from the parking lot, past the fence, and into this building with all sorts of huge pipes and exhaust systems protruding from the roof. It was an eerie feeling, and I remember likening it to Frankenstein's laboratory. Needless to say, I adjusted fine and I have truly enjoyed being where I'm at. I definitely see myself with LANL for years to come.

Leorrie Atencio



Sensors & Electrochemical Devices, MPA-11

Opportunity knocking
I joined MPA-11 in 2009 as a freshman in college looking for a job that would open the doors for a great career. It is safe to say that I would absolutely advise anyone who is given the chance to work for LANL. I've heard many people say that it's hard to have a job while going to college, but I can say that for me this is not true. I am currently a senior in college and have been able to maintain good grades for a full load of classes while working year-round at LANL. After completing my bachelor's of science degree in biology this spring, I hope to continue working at LANL.

Perks of the job
MPA-11 is a group of hardworking, ambitious researchers so you can be sure that there is always work to be done in preparation for the next project. I find joy in helping them. I do my part by preparing for domestic and foreign travel, managing files, and resolving day-to-day administrative problems such as setting up others for training, scheduling meetings, and bringing in new visitors. The busy days go by fast . . . every day something exciting happens.

Jon Rau *Attracted to big-picture challenges and chemistry's solutions*

At the end of the Cold War, the U.S. ban on underground nuclear tests put hefty demands on science. That's why in the late 1990s chemist Jon Rau began a new chapter in his career. He moved from basic research to investigations into how materials in nuclear weapons, which have outlived their original expiration date, are handling the aging process. "The materials were expected to have a finite lifetime, and they have behaved quite well," Rau said. "But now they are expected to perform decades beyond what was intended."

There are many materials in a nuclear weapon, including metals, high explosives, polymers, and ceramics. The aging of any one of these materials could affect performance. If the performance of an older weapon becomes questionable, scientists must decide how to replace the aging parts in order to restore performance.

That's where Rau's work fits in. He leads a specialized team of chemists, engineers, and high-level technicians in Materials Synthesis & Integrated Devices (MPA-MSID). "What we need to do is chemically understand these aging materials," Rau explained, "so designers and engineers have the information they need to assess when an aging material will have a negative impact on weapon performance."

His team's research, in many cases, reinforces confidence that certain materials are still viable. It's part of a body of research that allows the nation to extend the life of weapons rather than remanufacture weapons every few decades, which is tremendously expensive. During the Cold War, researchers designed and built nuclear weapons using materials that could be tested in underground nuclear tests. Now aging weapons are "tested" in computer simulations, which require a more complete understanding of weapon materials because a simulation must accurately predict how weapons parts behave during the detonation. "LANL's primary focus on weapon materials has been from a physics and engineering perspective," Rau said. "Now the chemical perspective has become more predominant."

Keys to Rau's success

"I've had a pretty wild career," said Rau, flanked by a world map and a chart of nuclides in his building's conference room. "The opportunities here are what you make of them. The more creative you are, the better the opportunities." Rau set out to be an engineer, but during college he grew interested in chemistry and participated in LANL's undergraduate student program, where he was involved in environmental sequestration research. After he received a master's degree in physical chemistry from the University of Wisconsin-Madison, the Laboratory's Chemical Sciences and Technology Division hired Rau 16 years ago as a technician to help study heterogeneous catalysts for selective oxidation of organic compounds and purification of diesel exhaust. Today, as a technical staff member in MPA he leads a number of materials-related R&D projects. He builds teams of scientists and engineers to solve a variety of problems relevant to the Weapons program, not just aging.

His team's biggest accomplishment—developing new materials in the interest of nuclear weapons safety—is about to come to fruition after five years of work. "It's very different from traditional work, and the military's in love with it," Steve Renfro, Weapons Engineering and Experiments acting deputy associate director, said. "People with 'general' and 'admiral' in their titles are talking about it."

Next, Rau will expand the Laboratory's ability to advance plutonium science. As part of a larger mission to reestablish crucial capabilities, which LANL leaders say have "suffered from post-Cold War neglect," Rau's team will develop new process chemistries to recover and recycle scarce isotopes and explore the use of plutonium-242 in research. LANL's Plutonium Science and Research Strategy explains the benefit: "Having a radioactivity some 16 times lower than plutonium-239, meaningful quantities of plutonium-242 metal and alloys can be used in radiological facilities that function under lower security and lower hazard levels . . . and where the national laboratories have unique instrumentation and capabilities to conduct state-of-the-art science."

Renfro attributes Rau's success to a handful of attributes: 1) He's a big-picture thinker, taking in the expanse of the Laboratory, the nation, and world politics as he goes about his business; 2) Before concocting new mixtures of chemicals, Rau extrapolates how various combinations could solve a problem the nation has been wrestling with for decades, or throw a troublesome kink in those efforts; 3) Moreover, Rau is a master listener who lives by the axiom, "If you're not listening, you're not understanding the problem."

Gus Sinnis and Juan Fernández *Influencing scientific directions*

Equipped with new skills gained from their experience as group leaders, Gus Sinnis and Juan Fernández are returning to full-time scientific research with insightful, practical approaches for guiding its direction. From the challenges of obtaining vital scientific tools to navigating the shifting winds of funding, they know how to keep science thriving.

Leading innovative research collaborations

Fascinated by the most extreme objects in the universe and the fundamental physical laws, Sinnis chose a career in experimental physics and set out to reveal at least part of the mysterious curtain that envelopes us. Before becoming Neutron Science and Technology (P-23) group leader, he was co-spokesperson for the Milagro collaboration, which pioneered the use of water Cherenkov technology to detect TeV gamma rays from the cosmos. Discoveries made by Milagro brought scientists closer to understanding the sources of the cosmic radiation.

Upon returning to research, Sinnis will work with the international High-Altitude Water Cherenkov Gamma-Ray Observatory (HAWC) collaboration, leading the analysis of physics results that will stream from the new observatory under construction in Mexico. HAWC will map the entire Northern Hemisphere in high-energy gamma rays and probe particle acceleration in supernova remnants, pulsar wind nebulae, supermassive black holes, and gamma-ray bursts. Like Milagro, it will operate nonstop and post findings in real time, allowing more sensitive observatories to zoom in and collect physical details before the phenomena disappears.

Using algorithms developed by Sinnis and collaborators, HAWC will discover transient phenomena. “When you build a new instrument with dramatically improved sensitivity, you will see things that no one has ever seen before,” said Sinnis, who has a PhD in physics from the University of Hawaii.

For the Long-Baseline Neutrino Experiment, Sinnis will lead the calibration of a new detector and develop laser ionization as the primary calibration system. Using neutrinos generated at Illinois’s Fermilab, the experiment will generate measurements that have the potential to explain why the universe is composed of matter, with essentially no anti-matter. The detector is located inside a liquid argon time projection chamber near Lead, South Dakota.

Leading diverse collaborations taught Sinnis many lessons that proved valuable when managing an organization as complex as his. “I tried to run P-23 as a collaboration between the staff and management,” he said. During his six years as group leader, he also went to bat for researchers, communicating their need for new equipment and supplies to those holding the purse strings. “It was the toughest part,” he said. Sinnis also learned that despite changes in research priorities, it’s prudent to maintain core capabilities, for which there might be demand again. “You always need a backup plan,” Sinnis said. “It’s research–things happen.”

Defining leading-edge research directions

A man of big visions, Juan Fernández said he worried he would be a discontent scientist if unable to fulfill them. Tak-

ing on leadership positions gave him the ability to influence his group's scientific direction and direct his own destiny as a researcher. Fernández has been Plasma Physics (P-24) group leader since 2006, and he has held other leadership roles since the group's formation in 1994.

"In high energy density physics (HEDP), we have developed scientific tools and capabilities at LANL with tremendous potential for weapons physics and inertial confinement fusion. We made the Trident laser the best intermediate-scale HEDP facility in the world, and we became the dominant group in ion acceleration in the world," Fernández said. "The challenges are large, but the opportunities are also large."

Ten people in P-24, including Fernández, helped set the national direction for the new field of high energy density laboratory physics, which includes the study of extremely hot, dense plasmas produced by lasers, ion beams, z-pinches, and electron beams. As a group leader deeply involved in research, he focused on relativistic laser-matter interactions and he served as principal investigator of several large, multi-institutional projects. Fernández is credited with notable publications, patents, national awards, new initiatives, and new facilities for experimental plasma physics.

Fernández thinks a next-generation, laser-driven ion accelerator could be the next big thing in plasma physics, as a tool for basic research that could boost conventional accelerators and enable fusion. An ion accelerator also could detect nuclear materials and–if packaged as a compact, small beam–might one day treat cancer at regional medical centers.

With his vision firmly set in place, he is now ready to devote himself solely to research. "I'm here for science," said Fernández, who has a PhD in experimental plasma physics from the University of California, Berkeley. "Deep down, I want to see science done."

As a young researcher, Fernández said he was like Don Quixote charging the windmills. His subsequent service in management, especially this last stint as P-24 group leader, helped him to grow and to shed his naïveté. He became adept at drafting realistic proposals and approaches to projects, while relying on the art of human interactions to make things run smoothly. Those skills will help him as he digs deeper in the fields of high energy density plasmas and relativistic laser-plasmas now.

Once a staunch critic of relativistic laser-matter interactions, Fernández gradually came around to the potential of that field and created a program around it. The ability to rethink his conclusions and connect the dots in new ways–creativity, in short–is Fernández's greatest strength as a scientist, he said.

Jian Wang *Developing the blueprint for tomorrow's super materials*

Even after attaining his doctorate in solid mechanics from Xían Jiaotong University in China, Jian Wang was left wondering why different materials behave the way they do.

"One question always bothered me: why do materials show different behaviors?" said Wang of Materials Science in Radiation and Dynamics Extremes (MST-8). For instance, why can copper be elongated, but not glass?

Wang realized he would never know the full story unless he learned the physics of materials at the atomic scale. Solid mechanics assumes that materials at the macro, continuum scale are homogenous in their behavior, without exploring the inherent atom-by-atom structures.

Leaving his farming roots in China to enroll at Rensselaer Polytechnic Institute in New York, Wang pursued a second PhD, in mechanical engineering, giving him the inside-out understanding of materials for which he hungered.

Scientists cannot accurately predict how a material's atomic-scale properties will play out when applied in bulk-scale manufacturing. But by drawing on his two fields of study, Wang is one of the few people in his group to analyze both scales through computer simulations, providing insights that could lead to the design of technologically advanced materials.

"That's what makes him unique," said Amit Misra of the Center for Integrated Nanotechnologies (MPA-CINT). For example, to understand why a material made of two soft metals feels rock-hard when squished, Wang and collaborators modeled the atomic-scale defects, developed a theory explaining how the material's behavior is shaped by its underlying defects, and successfully demonstrated the material at the laboratory scale.

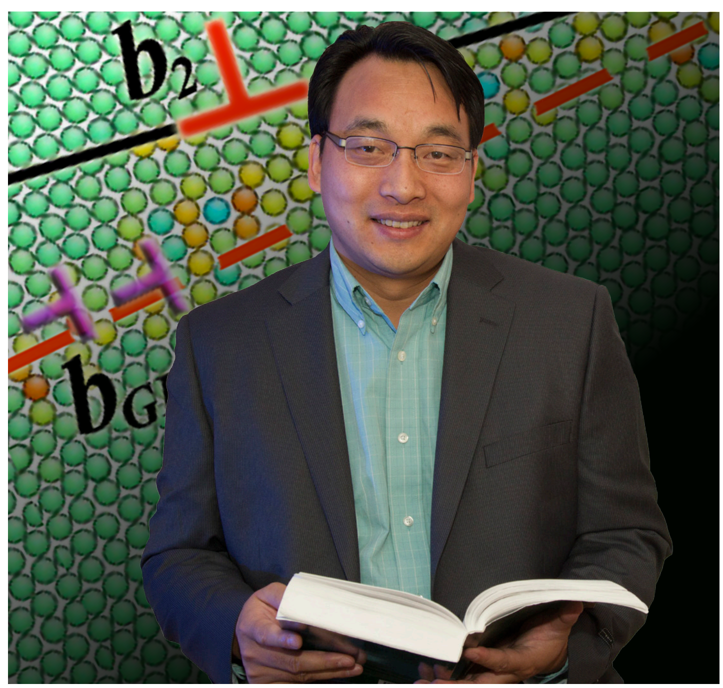
On a basic level, defects occur when a perfect structure is altered, Wang explained. Suppose you filled a box with ping-pong balls, placing them one by one in a distinct pattern. "Once you destroy the pattern at any position, then you introduce one defect," Wang said. "If you take one away or add one or shift the structure, it is no longer perfect. You've changed the structures and correspondingly altered the properties."

Wang's research into modeling the strength mechanics of nanolayered composites could lead to super lightweight, strong metals for transportation, weapons, and buildings in a decade or so. "All kinds of new technology will require materials which have super properties," said Wang. "In understanding the structure/property relations of materials, we could develop the principles of designing new materials."

Misra was impressed by Wang's long publication record when he and Richard Hoagland (MST-8) hired him as a postdoctoral researcher in 2006. "That is the one thing he has maintained throughout his career–his sheer productivity," Misra said. Wang averages more than 30 publications in high-profile, peer-reviewed journals a year. His ability to develop an idea into research, resulting in a published paper with such consistency, is a tribute to his self-motivation and focus, Misra said.

Wang received a 2009 Distinguished Postdoctoral Performance Award for his research using atomistic simulations to reveal defect interactions controlling the mechanical response of nanomaterials. He also received a 2011 Early Career Award through the Laboratory Directed Research and Development program for developing a novel materials modeling tool to predict mechanical behaviors of nanoscale materials by bridging atomic-scale and mesoscale knowledge together. He sits on the editorial board of the *Journal of Materials* and serves as a reviewer for several more publications, including *Science* and *Nature Materials*.

Even with two PhDs in hand, Wang said his curiosity still gets the best of him; he finds it difficult to dismiss the questions that pop up in his mind. "For my postdocs and students, I always tell them research is not about money. It's about being driven by curiosity–things that bother you," he said.



Hongwu Xu *Using minerals and neutrons to unearth solutions to global challenges*

Hongwu Xu likes dreaming up new ways to use neutrons to solve problems in earth and environmental sciences. As he's simulating the planet's deep water cycle or reproducing the realms of buried nuclear waste, he uses neutrons to probe water-bearing minerals or complex oxide materials. His research often demands high-pressure, high-temperature conditions, nearly as extreme as what's found in Earth's mantle.

"Neutrons are ideal for detecting light elements, especially hydrogen," said Xu, who uses the Lujan Neutron Scattering Center at Los Alamos for his neutron diffraction studies. The community of geoscience researchers using neutron techniques is small, Xu said, partly because neutron facilities are in short supply compared with x-ray facilities.

The Mineralogical Society of America named Xu a 2013 fellow, paying tribute to his talents in neutron diffraction, conventional x-ray scattering, and synchrotron x-ray studies—complementary methods of exploring the atomic structures of materials and revealing their properties.

Inspired by time-tested minerals, Xu studies synthetic copies or analogues—mostly polycrystalline powder or ceramic chunks—of minerals. His studies, for example, potentially can be used for turning liquid nuclear waste into a rock-like ceramic that, when placed in a metal canister and buried, won't leach into the environment.

"We learn from nature," said Xu, of Earth System Observations (EES-14). Since joining Los Alamos National Laboratory in 2004, Xu has fostered collaborations between the Earth and Environment Sciences Division and the Lujan Center. "New discoveries occur at the boundaries of different disciplines," he said. For five years, he has been a part-time instrument scientist assisting researchers at the national user facility and developing new research techniques. He is the only EES scientist who maintains an office at the Lujan Center.

For HIPPO, the High-Pressure Preferred Orientation Diffractometer, Xu and his colleagues developed capabilities that combine high pressure–up to 20 GPa–with temperatures ranging from a low of 8 to a high of 1800 K. The benefits are two-fold: researchers can simulate situations deep in the Earth or other planets, or they can create new materials with new properties. "Only a few places in the world have these kinds of high-pressure neutron capabilities," Xu said.

Xu's knowledge of minerals and materials science, stemming from his PhD in geosciences from Princeton University, made him a key player on the Lujan Center team that pioneered in situ high-pressure neutron diffraction methodologies. Using high-pressure fluid cells, for instance, his team studies the stability and structures of clathrate hydrates, a family of ice-like solids filled with various gases that are stable at high-pressure, low-temperature conditions. Found in the ocean floor sediments, methane clathrate is a potential energy resource, however, during landslides or earthquakes methane release can negatively affect climate. Xu is unraveling the mechanisms and kinetics of how different gas clathrates are formed.

Xu plans to expand the capabilities of other Lujan instruments and apply the techniques to broader earth, energy, and environmental studies. For example, through neutron scattering and imaging measurements coupled with multiscale modeling, his team may assess the suitability of salt repositories, such as WIPP, for storing high-level nuclear wastes—an urgent challenge for sustainable nuclear energy.

As well, his work on high-pressure conditions could be applied to research at MaRIE (Matter-Radiation Interactions in Extremes), the Laboratory's proposed experimental facility for the discovery and design of advanced materials. "Broadly speaking, pressure is an effective tool for designing new materials or tuning existing materials for new properties," he said. Xu has authored 82 publications in notable scientific journals and serves as an associate editor of *American Mineralogist.*

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